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COTININE AS A MARKER OF ENVIRONMENTAL TOBACCO SMOKE EXPOSURE: A REVIEW OF THE LITERATURE

This brief review is intended to highlight recent claims in the literature regarding cotinine as a marker for exposure to ETS.

According to the literature, cotinine analysis has been used in studies regarding the verification of (active) smoking history.

There are now a number of reports which claim that body fluid concentrations of cotinine are reliable markers for total exposure to ETS. Matsukura et al. report agreement in the level of cotinine per ng of creatinine in urine of nonsmokers with the number of cigarettes smoked by others in the indoor environment. Jarvis and Russell report that concentrations of plasma, saliva or urine cotinine correlate with self-reported exposure. Jarvis et al. (1985) argue that saliva cotinine measurement provides a valid marker of "dose" from ETS exposures. Greenberg et al., Wald et al. and Hoffmann et al. (1984) also report a dose-response relationship between urine (and saliva) concentrations of cotinine and self-reported ETS exposure levels. Hoffmann et al. (1984) support the Matsukura et al. contention that the best indicator of chronic ETS exposure is urinary cotinine-creatinine ratio.

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Pattishall et al. and Etzell et al. report significant dose-response relationships between serum cotinine and the number of smokers in the home, as well as with the amount smoked by those individuals. However, of those researchers who recommend the use of cotinine as a marker for ETS exposure, the urinary concentration of cotinine appears to be the medium of choice.

Cotinine appears to have a number of obvious advantages over other potential markers of ETS such as COHb, thiocynate or nicotine. As the major metabolite of nicotine, it is cleared from the body rather slowly. Neurath, Benowitz, and Knight et al. report a half life of plasma cotinine of 19 hours; Lynch estimates t1/2 at 15 hours, while Jarvis et al. (1984) and Andresen et al. report a t1/2 of 24 hours. Concentrations of cotinine in individuals are also believed to be constant over time. Knight et al. claim that concentrations within a given individual will vary by only 15-20% over the course of a day. It follows that sampling times for cotinine would be less critical than for other markers for assessment of daily ETS exposure.

However, the literature also contains ample criticism of the use of fluid cotinine as a quantitative marker of ETS exposure. Benowitz (1983), for example, argues that cotinine is an imperfect quantitative indicator of daily nicotine uptake in different subjects due to individual variability in both the conversion rates of nicotine to cotinine and the elimination rates of cotinine.

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Benowitz (1983) also notes that individual variations in renal clearance of cotinine imply that urinary cotinine would not be a good quantitative predictor of blood serum levels of cotinine.

Others have reported that (1) saliva cotinine levels may vary as high as an order of magnitude among nonsmokers exposed to ETS (Johnson et al.) and (2) serum concentrations of cotinine vary "widely" among different individuals (Hoffmann, et al. (1983)).

Furthermore, Johnson et al., in a comparison of analytical methods, report that radioimmunoassay yielded 30% higher readings for cotinine than did gas chromotography.

Obviously there does not appear to be a consensus among scientists regarding the efficacy of cotinine as a marker for ETS. However, the various claims supporting cotinine as a reliable marker for total exposure to ETS are plentiful. It has been argued, for instance, that cotinine measurements may be used to verify self-reports of ETS exposure in nonsmokers (thereby validating questionnaires) and that it may be used to quantify ETS exposure in children, as well as in nonsmoking spouses of smokers.

However, before the above claims are accepted, a number of points should be resolved. Some examples:

(1) What is the conversion rate of nicotine to cotinine and is it constant among different subjects?

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(2) What is cotinine's elimination rate in different individuals?

(3) Can cotinine be correlated to total ETS exposure, when the latter is measured by actual sampling and not simply by self-report?

(4) Which analytic method for cotinine is preferred?

(5) What are the relative strengths and weaknesses of the use of various body fluids, i.e., (a) urine, (b) saliva, (c) blood?

(6) What is the intercorrelation among (a), (b) and (c) (above) and what is the extent of interindividual variability for (a), (b) and (c)?

(7) Given the suggestion that most of nicotine in ETS is gas phase, what can be said of an undertaking which attempts to relate cotinine to nicotine and total particulates or total smoke exposure?

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